

Wyoming

Wyoming's social and economic development is driven, in large part by its natural resources. For more than 100 years, the U.S. Geological Survey (USGS) has been involved in studies of the geology, geography, water resources, and, more recently, the biological resources of Wyoming. Results of these studies provide natural-resource managers and policymakers with essential earth science information needed to make decisions about the use and conservation of Wyoming's resources.

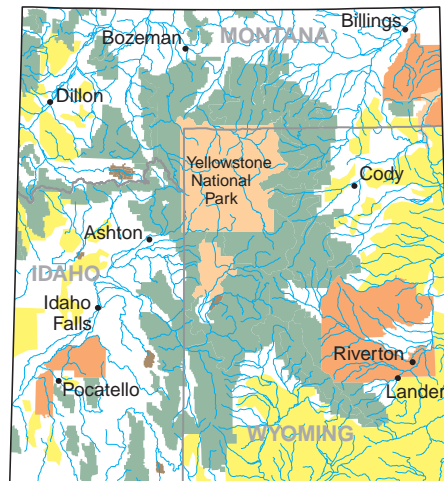
Integrated Geoscience Studies of the Greater Yellowstone Area

Integrated geoscience studies conducted by the USGS provide information that can be applied to the stewardship of the natural resources of Yellowstone National Park (YNP) and the Greater Yellowstone Area (GYA) (fig. 1). The studies include investigations of hydrothermal systems in relation to magmatic activity, caldera development, active faulting, fluid flow, ore-forming processes, and impacts on wildlife, plants, and climate. Additional studies include:

- using geophysics to understand the "plumbing" system of the Yellowstone caldera, geothermal systems, and to help locate active faults,
- surveying the bottom of the northern part of Yellowstone Lake to complement ongoing studies of active hydrothermal vents and explosion craters;

- mapping surficial mineralogy and vegetation communities to show the distribution of white pine, which will be used to define bear habitat,
- establishing a geochemical database to help evaluate the environmental health of YNP, including its wildlife, through time.

Geologic mapping is intended to provide information about geologic influences on environments of particular plant and animal species. Life cycles of some plants and the animals that eat the plants are affected by circulating hydrothermal water enriched with trace elements.



0 50 100 KILOMETERS
0 50 100 MILES

EXPLANATION

	National Forest
	National Park
	Indian Reservation
	National Wildlife Refuge
	Bureau of Land Management

Figure 1. Public lands in the Greater Yellowstone area.

The role of the USGS in the GYA, in cooperation with local, State, and Federal agencies, is to transfer and apply USGS technology, and to distribute information to the scientific community, citizens, public interest groups, and the media. Exhibits planned by the National Park Service (NPS) may include information from USGS studies and demonstrate the relevance of earth science to the stewardship of Federal lands.

The USGS is producing digital geologic maps (1:100,000 scale) for the GYA, as part of the National Geologic Map database. This activity is an initiative under the Greater Yellowstone Ecosystem program of the USGS, a cooperative program with the NPS, U.S. Forest Service, and other local, county, and State agencies in Wyoming, Montana, and Idaho. The digital geologic maps will be combined with other spatial databases for studies of wildlife habitat, geologic hazards, and the geochemical effects that different rock types have on water, plants, and animals in the area.

The USGS also has constructed digital orthophoto quadrangles (DOQ's) and digital elevation models (DEM's) for parts of the GYA (fig. 2). DOQ's are scanned aerial photographs for 7.5-minute quadrangles (scale 1: 24,000) in which distortion and displacements caused by the camera orientation and terrain are removed. DEM's are digital files of terrain elevations for ground positions at regularly spaced horizontal intervals. Ongoing work provides base-map data for the GYA in Wyoming, Montana, and Idaho. The data are

intended to be used for studying population demographics, estimating visitor and recreation demands, studying the effects of human and animal interactions, identifying geothermal hazards, studying noxious weeds and land use, and protecting natural resources.



Figure 2. Part of digital orthophoto quadrangle of the Old Faithful area in Yellowstone National Park.

Cartographic and Geographic Data

Through several programs the USGS produces and publishes basic cartographic and geographic data for Wyoming. Much of the work is in cooperation with other agencies. In one highly successful program, the Wyoming State Engineers Office, Wyoming Water Development Commission, State Lands Office, cities and counties, the Bureau of Reclamation, and the U.S. Department of Agriculture provide cooperative funding for producing DOQ's. Because DOQ's are referenced to ground control, the images may be loaded into a geographic information system (GIS) and used with other data for analysis. Of the 1,922 quadrangles for Wyoming, only about 300 remain to be mapped as DOQ's.

Other activities include the establishment of State data-sharing clearinghouses, with the help of the Federal

Geographic Data Committee; the clearinghouses are components of the National Spatial Data Infrastructure. Also, the Wyoming Natural Resources Data Clearinghouse of the University of Wyoming, the Greater Yellowstone Area Data Clearinghouse, and the Wyoming Spatial Data Clearinghouse of the State Office of GIS are partners with the USGS in making geospatial data accessible to the public. In addition to data coordination and sharing roles, the USGS is involved in the Wyoming Geographic Information Advisory Council, which provides leadership and establishes GIS policy for the State of Wyoming.

Yellowstone River Basin National Water-Quality Assessment

The USGS is studying water quality in the Yellowstone River Basin in Wyoming, Montana, and North Dakota as part of the National Water Quality Assessment Program (NAWQA). Water-resource managers need, but commonly lack, sufficient information for making effective management decisions and for evaluating long-term changes in water quality. Changes in water quality can affect an entire ecosystem, raising concerns about drinking-water quality, habitat degradation or destruction, and loss of use of the water. The Yellowstone River Basin NAWQA will provide needed information about surface- and ground-water quality and the factors that influence water quality in the basin.

Water-quality issues in the Yellowstone River Basin range from potential degradation of pristine streams in headwater areas to industrial and agricultural effects in downstream reaches. Specific issues include:

- trace elements (for example, selenium and arsenic) originating from sources such as leachate from mine spoils, leaching of soil, water

from geothermal areas, and uranium-rich rocks;

- toxic compounds from leachate, pesticides, hydrocarbons, and industrial and commercial waste;
- increasing salinity in ground and surface water;
- sediment problems in streams;
- effects of dewatering of aquifers;
- nutrient enrichment of ground and surface water from fertilizer application and from animal and human waste; and
- water quality on tribal lands.

Pesticide Monitoring of Ground Water

The USGS is conducting a pesticide-monitoring program, in cooperation with the Wyoming Department of Agriculture (WDA), in selected agricultural areas (potentially in all 23 counties) to determine the extent of pesticides in ground water. The WDA is implementing the State's generic Management Plan for Pesticides in Ground Water, in cooperation with other State and Federal agencies, for the U.S. Environmental Protection Agency. Increased pesticide use has raised concerns about the effects of pesticides on the environment and human health. Ground water, the sole source of drinking water for rural residents in many parts of Wyoming, is particularly susceptible to contamination.

Initial sampling by the USGS has been completed in Goshen, Park, and Washakie Counties and is underway in Laramie, Lincoln, and Fremont Counties. The sampling strategy was based on the potential vulnerability of ground water to pesticide contamination shown on maps created

by the University of Wyoming Spatial Data and Visualization Center (fig. 3). Eighteen pesticides and two degradation products were chosen for analysis.

Shallow alluvial and terrace aquifers typically were identified as the aquifers most vulnerable to pesticide contamination. Concentrations of all pesticides detected in water from wells in Goshen, Park, and Washakie Counties were less than the safe drinking-water standard or its equivalent established by the Wyoming Department of Environmental Quality for municipal supplies. These standards do not apply to private domestic well water, but the standards provide a reference to the acceptable amount of chemicals in drinking water. Atrazine was the most commonly detected pesticide. Trace amounts of atrazine were found in more than one-half of the water samples from the three counties in which the pesticide was detected.

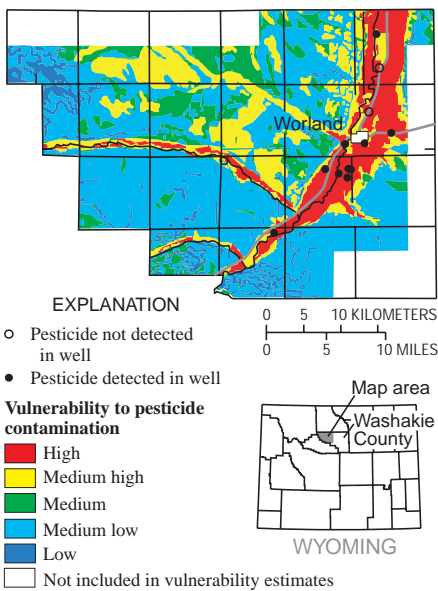


Figure 3. Locations of wells where water was sampled for pesticides, and the potential vulnerability of ground water to pesticide contamination in Washakie County.

Basic Hydrologic Data

The USGS, in cooperation with many local, State, and Federal agencies, collects hydrologic data at surface-water and ground-water sites throughout Wyoming. Depending upon the information needed, the data are collected continuously with automatic recording devices, intermittently, or by a single sample or measurement (fig. 4). Since 1888, streamflow data have been collected at more than 2,000 sites, and surface-water-quality data at more than 1,600 sites.

About 150 streamflow stations are operating (1999). All USGS data are available to the public; streamflow data from many stations are available in near-realtime on the World Wide Web. The hydrologic-data program is the foundation upon which most other water-resources investigations are based.

Although the USGS has no management or regulatory function, the short-term and long-term data acquired through this program have many uses. Local, State, and Federal agencies use the data for daily and annual management of Wyoming water, including allocation of water under State and Federal laws, enforcement of water-quality standards, and design of highway bridges and culverts. Also, the data are used for hydrologic investigations including:

- developing improved data-collection methods,
- describing and appraising water resources,
- determining the extent and severity of droughts,
- documenting floods and developing methods for estimating the magnitude of floods of a given frequency, and



Figure 4. A USGS hydrographer measuring streamflow. Photo courtesy of the Wyoming Tribune-Eagle.

- assessing the effects of human activities on surface-water and groundwater resources.

Invasive Weeds

To determine the impacts of invasive, nonnative plants on native plant communities in forest, grassland, and wetland habitats, USGS scientists are working in cooperation with the NPS, Bureau of Land Management (BLM) and Colorado State University. New sampling techniques are helping researchers pinpoint “hot spots” for exotic species and predict new areas of invasion. Habitats with the highest numbers of native species, including wetlands and streamside zones, are particularly vulnerable to nonnative weeds. In such areas, the invaders often spread at the expense of unique or narrowly distributed native species. Information gained in these studies is intended to help scientists propose cost-effective strategies for nonnative weed eradication and native habitat restoration.

Big Game Use of Reclaimed Mining Lands

Researchers at the USGS Wyoming Cooperative Fish and Wildlife Research Unit in Laramie compared

big game animals' use of native habitats and reclaimed mining lands. The results of this study are intended to help mining companies and government agencies design and implement reclamation projects in ways most favorable to big game. Pronghorn antelope, mule deer, and elk each showed distinct habitat preferences and distribution patterns, but all three used reclaimed areas during all or part of the year (fig. 5). Particular features of the vegetation on reclaimed lands were associated with greater use by different game species. Pronghorn, for example, preferred reclaimed sites on which alfalfa was present. Mule deer made consistent use of reclaimed grasslands, but elk used those areas only during late fall and winter.



Figure 5. Elk grazing on reclaimed mining land.

Energy-Resource Assessment

USGS scientists, in cooperation with the Wyoming State Geological Survey, BLM, Office of Surface Mining, and coal-mine operators, are assessing the availability, quantity, and quality of the coal, oil and gas, and coalbed methane in the State (fig. 6). One major objective is to generate, store, and manipulate the data in digital format so that it will be available for analysis by using a GIS. The digital database will provide information to potential users in a readily available format.

The coal-resource assessment includes gathering information about geography, stratigraphy, geochemistry, and quality of coal zones and beds in the State. Potentially minable coals included in the assessment are associated with the 55–65-million-year-old Fort Union Formation. The USGS has examined deposits in the Powder River, Hanna, Carbon, and Green River Basins. Mining of these coal resources, especially those in the Powder River Basin, contributes substantially to the State's economy through increased jobs and severance taxes.

Oil-and-gas resources in Wyoming are being assessed by the USGS as part of a national study of 18 priority provinces in the United States that are estimated to contain 90–95 percent of the Nation's known and undiscovered natural-gas resources. Provinces in Wyoming include the Greater Green River Basin and the Wyoming Thrust Belt. The study integrates all of the elements of the petroleum geology of a basin, including source-rock characterization, hydrocarbon migration, timing of migration and structural evolution, sequence stratigraphy, and reservoir quality.

Coalbed methane in the Powder River Basin is undergoing substantial development. The methane has been estimated to be as much as 39 trillion

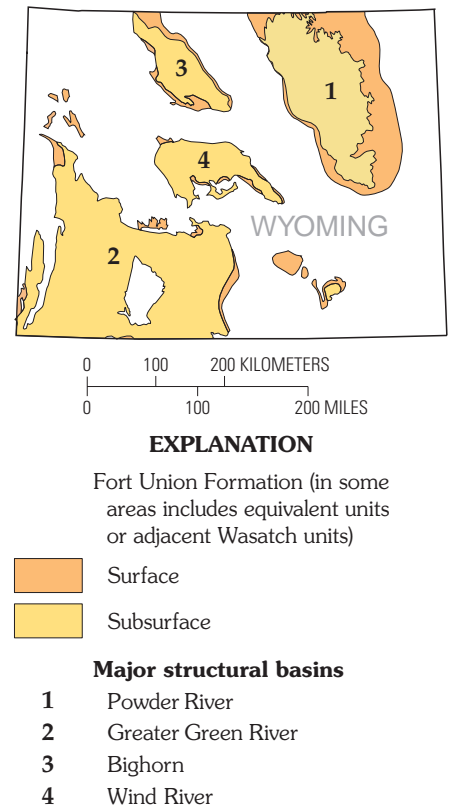
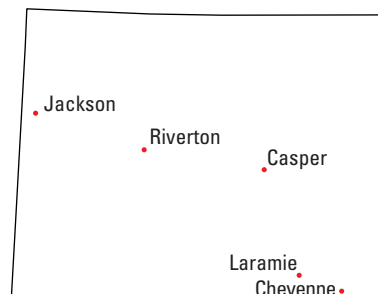


Figure 6. Energy-resource areas.

cubic feet. Resource managers need accurate basinwide and local gas-resource estimates and content analyses. For this assessment, USGS scientists are using data on coal geology, stratigraphy, and the reservoir to develop models of the basin. Chemical analyses and density measurements will be performed on coal cores collected from coalbed methane wells throughout the basin.

USGS office locations

The USGS has 49 employees in Wyoming



USGS State Representative

2617 E. Lincolnway
Suite B
Cheyenne WY 82001-5562
(307) 778-2931
FAX (307) 778-2764

USGS Home Page

<http://www.usgs.gov/>

Reports and products

1-888-ASK-USGS

